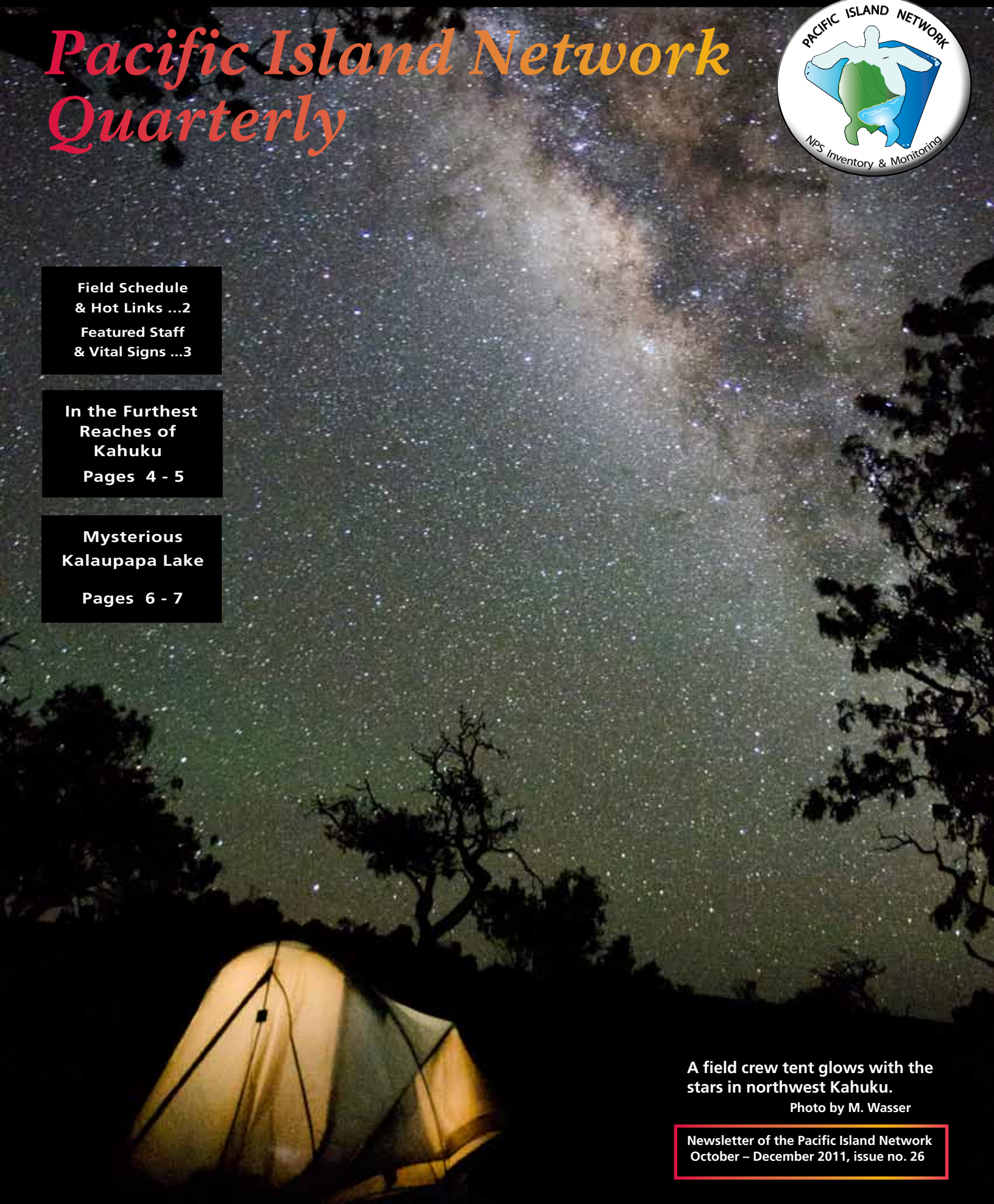
Inventory & Monitoring
Pacific Island Network

National Park Service
U.S. Department of the Interior

Pacific Island Network Quarterly



A field crew tent glows with the stars in northwest Kahuku.
Photo by M. Wasser

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National Park Service
U.S. Department of the Interior
Pacific Island Network
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The National Park Service (NPS) has implemented natural resource inventory and monitoring on a servicewide basis to ensure all park units possess the resource information needed for effective, science-based management, decision-making, and resource protection.

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NOTE: Unless indicated all photos and articles are NPS.
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Field Schedule

January

Water Quality Monitoring at KAHO & HALE

Vegetation and Landbirds Montoring transect clearing at HALE

February

Water Quality Monitoring at KALA, WAPA, AMME, ALKA & PUHO

Groundwater Monitoring at KAHO & AMME

Invasive Plants Monitoring at HALE (wet forest)

Landbirds Monitoring at HALE

March

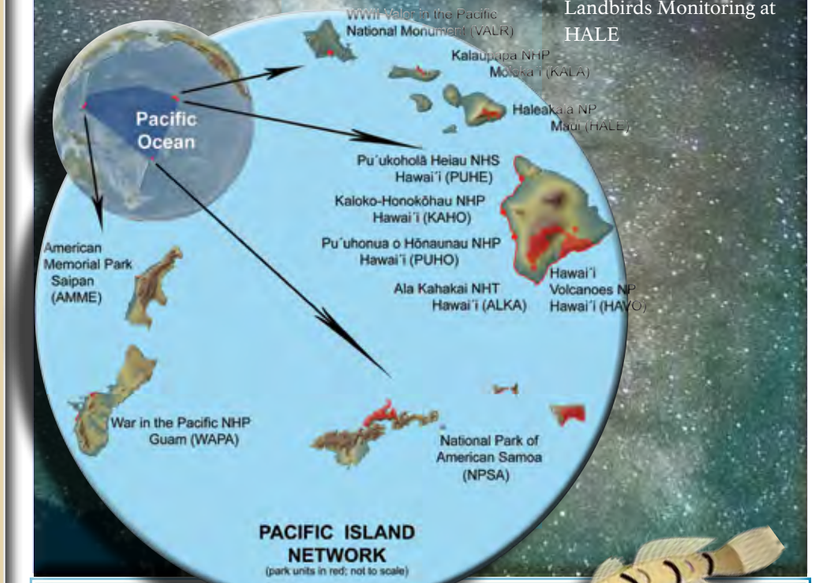
Water Quality Monitoring at NPSA

Benthic Marine and Marine Fish Monitoring at NPSA

Plant Community Monitoring training at HALE

Vegetation mapping accuracy assessment at NPSA

Landbirds Monitoring at HALE



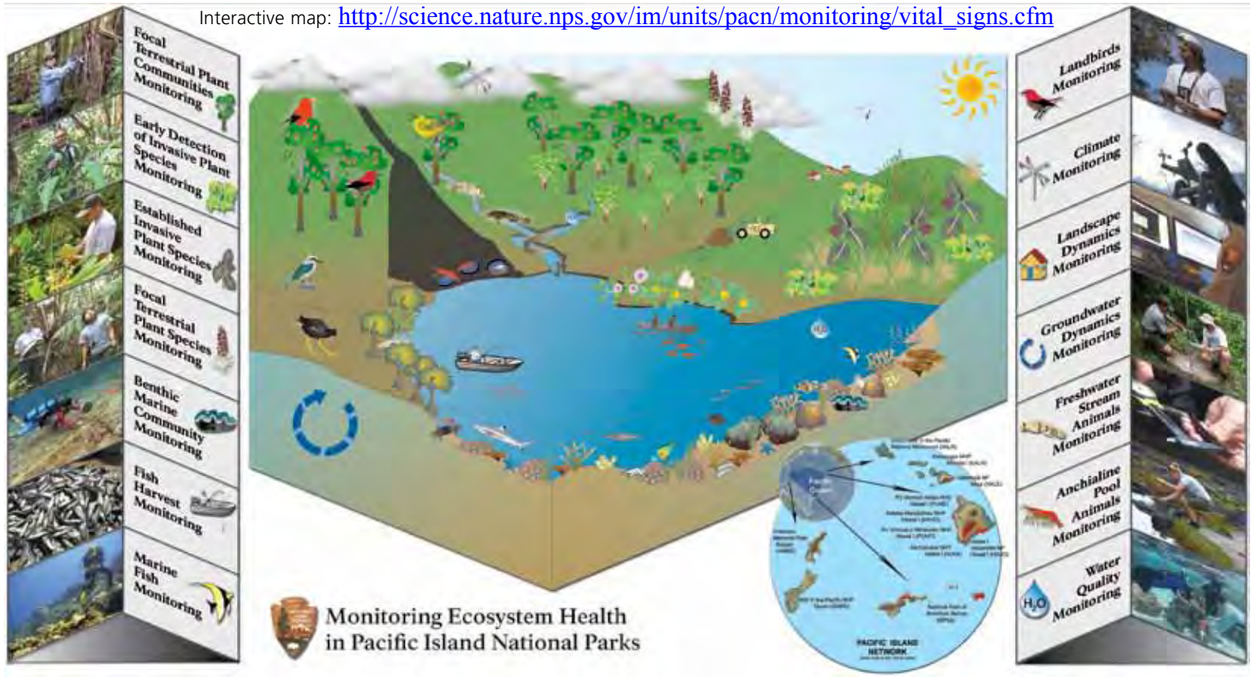
Hot Links

Stream Animals Video (New!)
http://www.youtube.com/watch?v=wFFl8Zo7lb4

Anchialine Pools Video
http://www.youtube.com/watch?v=mUwHxjA8uWE

Vegetation Maps for West Hawaii Are Ready for You !
PUHE: https://irma.nps.gov/App/Reference/Profile/2176695
PUHO: https://irma.nps.gov/App/Reference/Profile/2176789
KAHO: https://irma.nps.gov/App/Reference/Profile/2176800

Interactive map: http://science.nature.nps.gov/im/units/pacn/monitoring/vital_signs.cfm



Featured Staff

Woody Mallinson –*Biotechnician*

Before coming to Maui in 2006, most of Woody's life was spent in the Southeast. He was born and raised in Georgia, and received a B.S. in Biology from the College of Charleston in South Carolina. After graduating, he became an SCA intern with the NPS Southeast Exotic Plant Management Team in Asheville, North Carolina. Now he works for the Vegetation Management Program at Haleakalā National Park, and is currently funded by the Inventory and Monitoring Program. Between backcountry trips, he lives in Ha'ikū on the north shore of Maui, and spends most free time in the ocean. He feels fortunate to be at Haleakalā NP and in the islands.

Danielle Gross –*Biotechnician*

Danielle grew up in rural Maine and has dreamed of being a Marine Biologist since childhood. She became a scuba diver in high school and worked in Roger Williams University's marine lab before and after her graduation. Danielle contributed a year of volunteer service with the Hawksbill turtle project and I&M at Hawai'i Volcanoes NP before pursuing a Master's degree in Marine Science from Hawaii Pacific University. After a year on the mainland working for an oceanographic lab and research vessel in Oregon and she is excited to be back in Hawaii with her husband, and working with the National Park Service again.

Colin Meston –*Ecologist (SCEP)*

Colin grew up in Eugene, Oregon and attained his bachelor's degree from Oregon State University in Environmental Science; with emphasis in terrestrial ecology and soil science. The majority of his professional life has been in the field doing vegetation surveys. This year is his tenth season. This has allowed him to work in some of the most beautiful areas of Washington, Oregon, California, and Hawaii. As well as working for Haleakalā NP with funding from the I&M Program, he is back studying remotely with Oregon State University, working on a Master's of Natural Resources degree.

What Lies in the Furthest Reaches of Hawai'i Volcanoes National Park?

In 2011, the Inventory and Monitoring (I&M) vegetation team monitored wet forest and subalpine shrubland plant communities in the Kahuku unit of Hawai'i Volcanoes National Park (HAVO). The extensive pasture, wet forest, woodland, subalpine shrubland, lava flow, and cinder field plant communities found within Kahuku offer both unique opportunities and challenges for resource managers.

Few vegetation studies have been conducted in Kahuku and none have monitored plant community dynamics. A baseline inventory survey by HAVO staff (2006) identified important regions with rare native plants and regions with invasive plants. These data aided resource managers in the initial development of management priorities, but long-term plant community monitoring data are needed to quantify future changes and assess the effectiveness of management practices.

The I&M vegetation crew spent the past six months monitoring 60 plots (20 x 50 m each) in wet forest and subalpine shrubland communities of Kahuku. Field crews worked closely with HAVO staff to ensure employee safety during feral ungulate hunts, protect archeological resources, and coordinate fieldwork.

In July, a group of HAVO and I&M staff flew to the remote northwest corner of Kahuku (6,900 ft) via helicopter. During this trip, an endangered parsley (*Spermolepis hawaiiensis)*, rare endemic fern *(Polystichum haleakalense)*, rare seasonal endemic stinging nettle (*Hesperocnide sandwicensis)*, and seven non-native herbaceous species new to Kahuku were documented. The identification of certain rare species in this section of Kahuku warranted immediate management action (see sidebar on the far right).

Like most of Kahuku, this area continues to be significantly impacted by grazing, ground disturbance, and soil compaction from ungulates such as cattle, mouflon, sheep, and pigs. The extent of this impact is evident by the remnant vegetation composition. Before these mammals were present, this area was a native woodland dominated by naio (*Myoporum sandwicense*) and māmane (*Sophora chrysophylla*) trees with diverse native shrubs and grasses in the understory. Although some of the older trees are still present, there are few young trees to take their place. Furthermore, a groundcover of mostly non-native herbs now blankets large sections of the landscape.

Monitoring data from rarely visited areas of the park such as the northwest corner of Kahuku provide park managers with an important glimpse at the condition of these remote vegetation communities. These data provide a basic understanding of the amount and types of plant species in each part of the forest as well as identify new and rare species. Monitoring data also provide a way for park managers to compare different regions of forest or shrublands throughout the park and region.

The I&M vegetation team will continue to collaborate with park staff on field excursions to pool resources, and ensure prompt data sharing. All field data and summary reports for HAVO will be available this spring. The I&M team is gearing up for an exciting field season in the wet forests of Haleakalā NP and Kalaupapa NHP in 2012.

The only realistic way to access the remote northwest corner of Kahuku is by helicopter.

The I&M vegetation team surveys a plot through former pastureland. Non-native grasses carpet the ground.

–C. Yanger, NPS
Biological Technician
–A. Ainsworth, NPS
Botanist

A lone māmane tree symbolizes the havoc that grazing animals have on native ecosystems. Saplings have been quickly eaten for generations, leaving only the older, gnarled trees. Once these trees die, will there be any more māmane?

Kahuku Plant Highlights

The native Hawaiian fern *Polystichum haleakalense* was found within the subalpine shrubland community on Mauna Loa volcano within Hawai'i Volcanoes National Park. Prior to this collection, *P. haleakalense* was only known from Haleakalā and Mauna Kea volcanoes. Ka'upu (*Polystichum hillebrandii*), a rare fern to the park was also recorded. These ferns represent two of the three endemic *Polystichum* species found in Hawaii.

This rare native Hawaiian fern, *Polysitichum haleakalense,* was found in Kahuku.

USGS photo

The māmane (*Sophora chrysophylla*) -naio (*Myoporum sandwicense*) woodland community in the northwest corner of Kahuku is rare in the park and highly threatened by feral goats, sheep, and pigs. The loss of māmane trees from feral animals in similar woodlands on Mauna Kea is thought to be the primary reason the palila (*Loxioides bailleui*), a Hawaiian honeycreeper, is critically endangered. Today, palila are restricted to less than 10% of their historical range and the park's māmane-naio woodland represents a potential new introduction site.

A number of new non-native herbs were documented in Kahuku. These naturalized herbs present yet another threat to the remaining native plant communities:

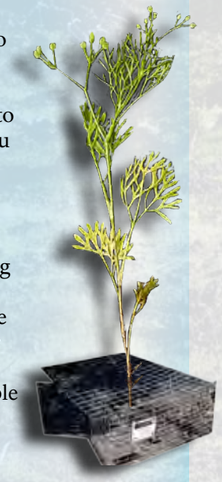
- lesser swinecress (*Coronopus didymus*)
- alfilaria (*Erodium cicutarium*)
- corn speedwell (*Veronica arvensis*)
- necklace weed (*Veronica peregrina*)
- *Achyranthes aspera*
- American carrot (*Daucus pusilis)*
- small-flowered catchfly (*Silene gallica)*

A large patch of pōpolo kū mai (*Phytolacca sandwicensis*) was found just outside of a monitoring plot within the former pasture section of Kahuku. Pōpolo kū mai is rare to the park and this patch is particularly important because it will serve as a critical seed source for resource management's ongoing wet forest reforestation efforts.

This patch of pōpolo kū mai (*Phytolacca sandwicensis*) is a rare and exciting find.

The Story of an Endangered Garnish?

Last July, while in the field with the Inventory & Monitoring vegetation monitoring team conducting surveys in the remote northwest region of Kahuku, we found a single *Spermolepis hawaiiensis*. This plant is a federally listed endangered species in the parsley family (although not the kind sprinkled on pasta) that had not been seen in Hawai'i Volcanoes National Park since 1944. Known only from a single collection (Fagerlund & Mitchell 557) within the historical section of HAVO, this species was presumed to have been eliminated from the park.



In September, two HAVO resource managers and myself flew back to northwest Kahuku and erected a small exclosure around the plant to protect it from non-native grazing animals. While the plant has since died (*Spermolepis* are annual), park managers were able to collect seeds for propagation. We are hopeful that with the protection from the exclosure, a new population will establish and this rare species will once again be found within Hawai'i Volcanoes National Park.

–M. Wasser, NPS-HAVO
Botanical Field Technician

Note: Above photos of Spermolepis and exclosure are not to scale

Mysteries on Moloka'i: Odd Invertebrates

As we descended into Kauhakō crater in Kalaupapa National Historical Park on Tuesday morning, November 1st, an unusual smell of rotten eggs wafted up from the lake in the crater's inner pit. We descended further and the smell intensified. At the lake's edge, the normally bright green water was a dark, foreboding blue-green. The normally abundant shrimp (*Palaemon debilis*) and aquatic insects were nowhere to be seen. "What", we asked ourselves, "had happened to the lake since our last visit?

Palaemon debilis, a normally common species in Lake Kauhakō. Photograph: Yuko Stender

Lake Kauhakō at the bottom of Kauhakō Crater on the Kalaupapa peninsula, is one of the most unique lakes entrusted to the National Park Service.

With a depth estimated at 832 feet, Lake Kauhakō has the greatest ratio of depth to surface area of any lake in the world.

The lake has brackish water at the surface, with salty, anaerobic (no oxygen) water at depths greater than 6 feet. However, there is no evidence to suggest that Lake Kauhakō has an open connection to the sea, even though it sits at sea level and is in close proximity to the Pacific Ocean.

The plants and animals in Lake Kauhakō are normally restricted to the shallow, oxygen-rich surface layer. Nutrients in this upper layer support a dense and highly productive phytoplankton community, which in turn sustains invertebrates such as the native *palaemonid* shrimp. Below this layer, special bacteria survive by extracting energy from sulfate in the water. As a by-product, the bacteria produce a gas called hydrogen sulfide (H_2S), which smells of rotten eggs.

When we visited the lake in August 2011 for regular water quality testing, all appeared normal. However, after the November visit and the sulfurous smell, we began asking other community members if they had noticed the odor. Based on their reports, it appears that sometime after our August survey and before September 27, 2011 the lake began emitting hydrogen sulfide gas into the atmosphere, possibly the result of an "overturning" event in the lake.

Typically, an overturning event is caused by strong winds generating a convection current that starts on the surface and cycles through a water body like a conveyer belt. At Lake Kauhakō, however, the surface winds are not strong enough to create this current and cause upwelling of the deeper water. Rather, the deep, hydrogen-sulfide rich water may have come to the surface by one of two means: 1) a landslide which disrupted the boundary layer between the surface and deeper water layers, or 2) prolonged drought which resulted in evaporation of the brackish, oxygen-rich surface layer. Whatever the cause, the lake began to undergo a series of dramatic transformations on a daily basis, sometimes shifting water color several times within a day (see next page).

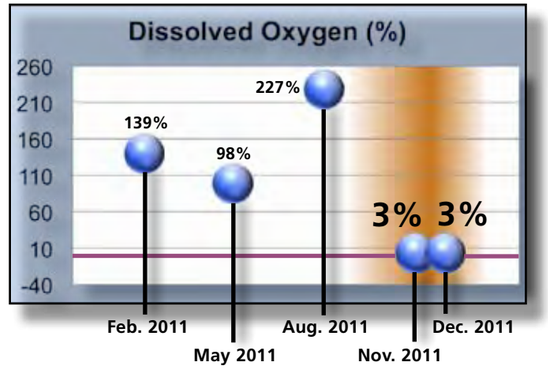
Our water quality monitoring efforts captured the dramatic changes that occurred in the surface waters of the lake as a result of this overturning event (see graph at bottom). After overturning, the surface water was saltier, more acidic, and most noticeably, lacking in oxygen (often >100% saturated, now only 2-3% oxygen).

No wonder the shrimp couldn't survive! Phytoplankton in the lake also disappeared, and the water became extremely clear. Interestingly, two new-to-this-lake invertebrates were found, so it was not completely devoid of life.

One of the never-before-seen invertebrates in the anaerobic waters of the lake was this rat-tailed maggot (*Eristalis tenax*) which is the larva of a species of hoverfly.

Its "tail" is actually a long breathing snorkel. This maggot can live in oxygen deprived and even polluted water.

Although scientists had long suspected an event like this could occur in Lake Kauhakō, such an event had never been physically recorded at Kalaupapa. However, similar overturning events have occurred in stratified (layered) lakes in Africa, with devastating consequences. Lake Nyos in Cameroon partially overturned in August 1986, belching large quantities of carbon dioxide (CO_2) into the air and suffocating 1,700 nearby villagers. The H_2S gas emitted by Lake Kauhakō is extremely poisonous in high concentrations (>300 parts/million). CO_2 (which is odorless) may also have been emitted from the lake. Fortunately, the effects of this event appear limited to the lake itself, since no dead animals such as deer or birds have been found in the crater.



After the overturning event (brown) the upper water layer of Lake Kauhakō contained dramatically less oxygen. It was also more acidic and saltier.

As we continued to monitor the changes in the lake, we began to wonder if and when it would recover. On December 12, the lake water was clear, no shrimp were observed, and a hydrogen sulfide smell was still detectable in the air.

Heavy rains fell on Kalaupapa over the next 48 hours, causing a rapid and dramatic change in the lake. When we returned on December 14, we immediately noticed the lake was a bright green color, no smell was detected, and most incredibly, two *palaemonid* shrimp were spotted swimming along the rocky shore. It appeared the rain built a new oxygen-rich surface layer on the lake, trapping the anaerobic waters below. Phytoplankton had already begun to bloom, turning the water a murky, bright green (nearly normal color). The shrimp, which can survive for long periods under adverse conditions, had also begun to recover.

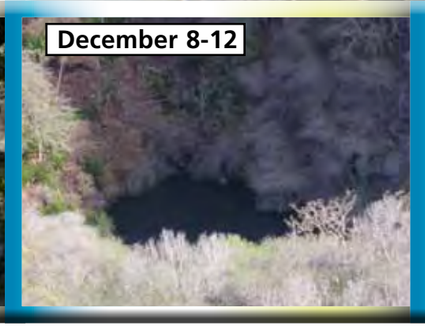
The recovery, however, was short-lived. The lake was back to a dark, blue-green color on December 16 with no signs of life. We will continue to monitor the lake, but there is now hope that the lake can renew itself in a short time span given the right conditions such as an abundance of rain. The mystery continues to unfold as we enter 2012.

–E. Brown, NPS-KALA
Marine Ecologist
–K. Tice, NPS
Biological Technician

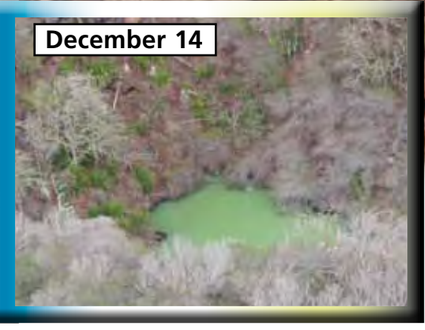
...and a Lake that Changes Color

September 27: This is the first known photo after the overturning event.

After the overturning event, Lake Kauhakō underwent a series of color changes. November 1: the surface of the lake had a milky white layer, most likely caused by a bloom of sulfide oxidizing bacteria.



December 8 and 12: in the absence of phytoplankton, the lake was clear with a deep blue-green color.



December 14: after heavy rainfall, the lake had turned bright green as a result of a phytoplankton bloom.